

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : D02G 3/40, D05C 17/02	A1	(11) International Publication Number: WO 99/14408 (43) International Publication Date: 25 March 1999 (25.03.99)
(21) International Application Number: PCT/US98/19745 (22) International Filing Date: 18 September 1998 (18.09.98) (30) Priority Data: 08/933,822 18 September 1997 (18.09.97) US (71) Applicant: ALLIEDSIGNAL INC. [US/US]; 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07962-2245 (US). (72) Inventor: BOWERS, Charles, Edward; 3000 West Broadway Street, Hopewell, VA 23860 (US). (74) Agents: CRISS, Roger, H. et al.; AlliedSignal Inc., Law Dept. (R. Fels), 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07962-2245 (US).		(81) Designated States: AU, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: YARN WITH HEAT-ACTIVATED BINDER MATERIAL AND PROCESS OF MAKING (57) Abstract Yarn suitable for tufting comprises a base fiber ring spun or wrap spun with a second fiber at least partially comprising a heat-activated adhesive material such that the yarn includes from 0.1 to 12, preferably 0.25 to 10, weight percent adhesive material having a melting point within the range of 105° to 190 °C, more preferably 165° to 190 °C. A preferred base fiber is a synthetic staple fiber bundle. A preferred wrapping or insert fiber is a copolyamide fiber, including ternary copolyamides of the 6/66/12 type. When the yarn is twist set by conventional processes and then tufted into carpet, the resulting carpet displays enhanced wear and appearance properties.		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

YARN WITH HEAT-ACTIVATED BINDER MATERIAL
AND PROCESS OF MAKING

This is a continuation-in-part application of pending Serial No. 08/792,819
5 filed January 30, 1997 which is a continuation of Serial No. 08/516,506 filed
August 17, 1995 (abandoned) which is a continuation of Serial No. 08/067,413
filed May 25, 1993 (abandoned) which is a continuation of Serial No. 07/436,962
filed November 15, 1989 (abandoned) which is a continuation of Serial No.
06/934,389 filed November 24, 1986 (abandoned).

10

1. Field of the Invention

The invention relates to yarn suitable for tufting, especially to form carpet
face fiber, and other applications. The yarn comprises a blend of fibers including a
first, preferably synthetic, base fiber, ring spun or wrap spun with a second fiber
15 that at least partially comprises a heat-activated adhesive material having a melting
point substantially below that of the base fiber. In a process for production of a
yarn suitable for tufting, particularly for use in a carpet, exposure of the yarn to
usual process conditions for twist setting the yarn causes the heat-activated
adhesive material in the inserting or wrapping fiber, as appropriate, to melt
20 substantially completely and flow to points of intersecting base fiber filaments to
create a bond upon subsequent cooling, thus altering properties and performance
of the resulting product.

2. Description of Related Art

25 It has been known to blend non-adhesive fibers with potentially adhesive fibers to
form a yarn or other textile structure or article, then to activate the potentially
adhesive fibers to bond them to contacting fibers, thus modifying end-use
properties of the yarn. U.S. Patent 2,252,999 to Wallach, issued August 19, 1941,
provides a process wherein a yarn comprising an admixture of non-adhesive and
30 potentially adhesive fibers is formed, the potentially adhesive fiber is activated, and
the fibers compacted while in an adhesive condition so that they adhere to each

other at points of contact. U.S. Patent 3,877,214 to Van der Werf, issued April 15, 1975, discloses a twist-free yarn comprising a polyamide fiber melting under a relatively low temperature as a bonding component. U.S. Patent 3,494,819 to McAlister, issued February 10, 1970, discloses a blend of fusible and non-fusible polyethylene terephthalate fibers incorporated into fabric, wherein the finished fabric is heated to fusion temperatures to provide improved pill resistance. U.S. Patent 3,978,267 to Selwood, issued August 31, 1976, discloses a substantially twistless compact yarn comprising a proportion of potentially adhesive fiber which has been activated to bond contacting fibers.

10 Cut-pile carpet is customarily produced from staple yarns or bulked continuous filament yarns. For example, staple fiber is conventionally carded, pinned, and spun or wrap spun into a singles yarn, which typically is twisted and plied with similar yarn to form a 2-ply or 3-ply yarn construction. This yarn is twist set by utilizing one of several commercially available twist setting processes
15 such as the Suessen or Superba processes.

 In a typical process the yarn is passed through a heated chamber, while in a relaxed condition. The temperature of this process step is crucial to the proper twist setting of the base fiber, to obtain desired properties of the final carpet product. For nylon-6 base fiber, the conditions for this step are typically 190-
20 200°C with a residence time of about 60 seconds for the Suessen process and about 125-140°C with a residence time of about 60 seconds for the Superba process. The Superba process utilizes saturated steam and thus the yarn is subjected to a much higher level of humidity than in the Suessen process.

 Similarly, bulked continuous filament yarn is produced
25 according to various conventional methods. Twisting, entangling, or direct cabling may be utilized in various processes. For example, a 2-ply twisted yarn combining 2 ends of 1185 denier 70 filament nylon-6 yarn is prepared and subjected to conventional twist setting conditions, such as that for the staple yarn above, or in an autoclave at 132°C in saturated steam with a residence time of
30 about 40 to 60 minutes.

It is known to wrap fiber, both staple and continuous filament, with a binder strand to physically bind the wrapped fiber to permit downstream processing. See, e.g., U.S. Patents 4,495,758 to Stahlecker et al. and 4,668,553 to Scott et al. Neither of these patents, however, uses or suggests the use of a binder strand or fiber that contains heat-activated adhesive material.

Multiple ends of the twist set yarns are tufted into cut pile carpet and conventionally finished to obtain the desired carpet product.

SUMMARY OF THE INVENTION

Yarn, preferably synthetic, comprises at least one bundle of fiber, the fiber being ring spun or wrap spun with a second fiber (either an insert fiber in the case of ring spun or a wrapping fiber in the case of wrap spun) comprising a heat-activated binder material, preferably a fiber, having a melting point range of about 105 to 190°C, preferably 165 to 190°C, under ambient humidity conditions, such that the yarn comprises a total of 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent binder material. The preferred fiber bundle comprise staple fibers, preferably in the form of a sliver. Alternatively the bundle of fibers may be continuous filaments. The preferred second, binder fiber is a copolyamide, more preferably a copolyamide of the nylon 6/nylon 6,6 type. The preferred bundle of fiber is nylon 6. The present invention is also an article, preferably tufted, more preferably a carpet, made from this yarn. The present invention is also a process of producing a yarn suitable for tufting, the process comprising the steps of:

- a. forming a bundle of fiber, preferably by spinning staple fiber;
- b. ring spinning or wrap spinning the bundle of fiber with a second fiber comprising a heat-activated binder material having a melting point range of about 105 to 190°C, preferably 165 to 190°C, under ambient humidity conditions to form a yarn comprising 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent of the binder material;
- c. heating the yarn sufficiently to melt the binder material; followed by
- d. cooling the yarn, preferably during twist setting, to solidify the binder material.

With ring spinning, the insert fiber is inserted before the front delivery roll into a continuous bundle of base fibers, preferably staple fibers in a sliver. This invention also relates to yarn made in accordance with the aforesaid process.

When the yarn is twisted, plied and twist set by conventional processes, for example 190-200°C Suessen twistsetting with a residence time of about 60 seconds, and the treated yarn tufted into cut-pile carpet, the resulting carpet displays enhanced carpet tuft appearance, improved resilience, and reduced change of appearance with use.

10 DESCRIPTION OF THE PREFERRED EMBODIMENT

Applicant has discovered that by incorporation of a minor proportion of heat-activated binder fiber having substantially lower melting point than the base fiber into the yarn construction, the standard heat conditions for twist setting the yarn will cause the binder fiber to melt, substantially losing its identity as a fiber. It will flow to intersecting points of base fiber and upon subsequent cooling will encapsulate and bind fibers and yarn together, thereby retaining the twist in cut-pile carpets. Carpets made with the yarn of this invention can be improved in surface, aesthetics, hand, durability and wear performance. By careful selection of the binder fiber desired improvement is "built-in" to the yarn, with no additional process steps required by the yarn spinner, the carpet manufacturer, or in dyeing and finishing.

The base fiber is selected from known synthetic fibers suitable for carpet use; such as, polyamides, nylon-6 and nylon-6,6, polyesters, and polyolefins, as well as material fibers, such as cotton and wool.

25 The binder fiber is selected to provide good adhesion to the base fiber. It is important that the melting point of the binder fiber be in the range of 105-190°C, preferably 165-190°C, under ambient humidity conditions. This range ensures that the binder fiber will melt during the conventional twist setting process yet will provide adequate adhesive properties during any subsequent dyeing steps and final use. A saturated steam environment, such as in an autoclave, reduces the fiber melting point of polyamide binder fibers dramatically.

A preferred class of binder fiber for use with polyamide base fibers are copolyamides within the specified melting point ranges. Suitable copolyamides of the 6/66/12 type and a process for their production are disclosed in U.K. Patent 1,168,404, issued October 22, 1969 to Inventa A. G., incorporated herein by
5 reference. A melt bonding copolyamide adhesive fiber is commercially available from EMS as GRILON® type K 140 (melting range 130-140°C) and type K 115 (melting range 110-117°C) copolyamides of the 6/66 Type as in U.S. Patent 5,478,624 to Lofquist.

The binder fiber can be blended, wrapped around, or
10 inserted into base fibers, and the resulting fiber blend can then be processed in known ways. It is important to ensure a thorough blending when the binder fiber is blended with base staple fiber to avoid potential clumps in the finished carpet. The fiber blend should contain 0.1-12 weight percent binder fiber, preferably 0.25 to 10 weight percent, and more preferably 5 to 8
15 weight percent. Higher amounts cause undesirable harshness of hand due to the conditions of the twist setting process causing the binder fiber to melt substantially completely. Ring spun or wrap spun yarns prepared from such a fiber blend and subjected to thermal activation can provide strength properties approaching that of bulked continuous filament (BCF) yarns. Properties of BCF yarns can also be
20 enhanced.

By selection of the thermally activated binder fiber within the weight percent ranges and melting point ranges specified it is possible to modify end-use properties of the finished carpet to improve wear resistance, resilience, reduced change of appearance over time and with use, and to increase
25 hand, lustre and apparent value. Denier per filament, cut length, fiber cross-section, crimp type and frequency, surface finish, melt viscosity, softening point, melting point, dye affinity, and other properties are crucial to achieving ideal properties in the final product. A proper selection of the binder fiber must be made to obtain the desired, or optimum results from the finished carpet product.
30 This will depend on numerous factors including the denier, length, crimp, finish, and other properties of the base fiber product.

With the utilization of this invention, twist setting conditions normally used are sufficient to activate the binder fiber, to create bind points which strengthen the final product, thereby imparting other characteristics which are desirable. For the Suessen process, under relatively low humidity conditions, the twisted yarn is
5 subjected to a temperature of 190-205°C for a residence time of 50-60 seconds. In the Suessen process motion of the fiber while in the relaxed state, caused by vibration or air currents, sufficiently motivates the molten binder fiber to flow to the intersecting "touch points" of the base fiber, as a function of the melt flow properties of the binder fiber and surface characteristics. As the fiber emerges from
10 the elevated temperature condition, the binder solidifies and encapsulates or bonds two or more base fibers together at intersecting points in a durable bond. Subsequent processing including dyeing, finishing, and backcoating using commercial processing methods does not soften the bond points sufficiently to weaken them, but rather will strengthen them. The resultant carpet can be of many
15 forms, but a typical style would be cut-pile carpet with about 40 ounces per square yard of face yarn including the binder, with an attached backing. Carpet construction would be typically 5/32" gauge, 3/4" pile height, and the carpet would be dyed, dried, backcoated, and sheared using normal processing techniques. The yarn of the invention would also provide important property improvements in the
20 production of loop-pile carpet.

EXAMPLE 1

A blend of staple fiber was produced with 3 weight percent GRILON® Type K 140 copolyamide fiber having a melt point range of 130-140°C and 97 weight percent
25 base staple fiber (AlliedSignal Type 521 nylon-6 fiber having a melt point range of 215-225°C).

The blended fiber was carded, pinned, and ring spun into a singles yarn by conventional processing methods. The yarn, a 3.0/1 cotton count yarn containing 4.7 "Z" twists per inch, was plied with a similar yarn to
30 produce a 2-ply 3.0/2 cotton count 4.7Zx4.0S yarn. The 2-ply yarn was twist set by a conventional Sussen twist setting process. The yarn was passed through a

heated chamber at about 195°C while in a relaxed condition, with a residence time of about 60 seconds.

Multiple ends of this yarn was tufted into cut pile carpet and conventionally finished to obtain the improved product.

5 The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent base staple fiber. The carpet containing the binder staple fiber blend displayed enhanced carpet tuft appearance, more resilience, and better wear resistance.

10

EXAMPLE 2

Carpets also may be produced from bulked continuous filament (BCF) yarns, and carpets thus made can be improved in surface, aesthetics, hand, or in durability and wear by using this invention. In the following example the carpet manufacturer simply uses normal processing techniques to
15 obtain the desired effect.

Filament nylon yarn is produced according to various conventional fiber producer manufacturing methods. These methods are not particularly related to the invention, except that another, smaller, filament yarn will accompany a base yarn throughout subsequent process steps. Often
20 the combination will result in a 2-ply, 3-ply, or other form needed for the carpet style.

In various processes, twisting, entangling, or direct cabling may be utilized. Direct cabling is often used, as in this example, where a 70 denier 14 filament yarn is combined with a 1185 denier 70 filament in the
25 creel of the direct cabler to produce a yarn with 3.5 "S" twist per inch in each of the singles and 3.5 "Z" twist in the resultant 2-ply twisted yarn (1185 x 2 ply). The final yarn contains a third component, a binder yarn, which has a lower melting point and which will lose much of its identity in subsequent process steps, as it is melted and flows to bind fibers and yarn together, thereby
30 retaining the twist in cut pile carpet.

In this example, the 70 denier 14 filament yarn is a copolyamide having a

Multiple ends of this yarn was tufted into cut pile carpet and conventionally finished to obtain the improved product.

10 EXAMPLE 2

Filament nylon yarn is produced according to various conventional fiber producer manufacturing methods. These methods are not particularly related to the invention, except that another, smaller, filament yarn will accompany a base yarn throughout subsequent process steps. Often the combination will result in a 2-ply, 3-ply, or other form needed for the carpet style.

In this example, the 70 denier 14 filament yarn is a copolyamide having a

melt point range of 105-180°C and results in the binder fiber for the combination, combined with 2 ends of 1185 denier, providing a blend of about 2.8 percent binder. This ratio can be doubled by using two binder yarn ends, or varied by providing other denier products to the system.

5 When the product is subjected to conventional twist setting, the binder is activated producing a final product with the desirable characteristics of enhanced carpet tuft appearance, more resilience, and better wear resistance than similar carpets not containing the binder. The twist setting conditions for this are typically 270°F, in saturated steam, with a residence
10 time of about 30-50 seconds for the superba twist set process or 40-60 minutes for the autoclave twist set process. As the fiber emerges from the elevated temperature condition, the binder solidifies and encapsulates or bonds two or more base yarns together in a permanent or durable bond.

 Multiple ends of these yarns are tufted into cut pile carpet and
15 conventionally finished to obtain the improved product.

EXAMPLE 3

 Carpets also may be produced by introducing a binder yarn as the wrapper yarn that is placed uniformly around a continuous bundle of base staple fibers at
20 wrap (hollow spindle) spinning to produce a wrap spun yarn. The binder yarn can consist of 100% heat-activated adhesive fibers or consist of a blend of heat activated adhesive fibers and non-adhesive fibers. Binder yarns as such can be either continuous filament yarn or spun staple yarn produced by conventional manufacturing methods.

25 When the resulting wrap spun yarn is twisted into a plied yarn, twist set by conventional process, and the treated yarn tufted into cut-pile carpet, the carpet displays enhanced carpet tuft appearance, more resilience, and better wear resistance than similar carpets not containing the binder yarn. These carpet improvements can be further enhanced by the continuous bundle of base
30 staple fibers being a blend with a low weight percent of heat activated adhesive fibers and a high weight percent of non-adhesive fibers that is wrapped with

a binder yarn as described above.

In this example, the continuous bundle (sliver) of base staple fibers is 100% 17 denier per filament AlliedSignal T317 nylon-6 staple fibers that is wrapped with a 30 denier 12 filament yarn at wrap spinning to produce a 3.35/1 cotton count
5 yarn containing 5.2 "Z" wraps per inch. This singles yarn is then plied with another singles end of the same yarn to produce 3.35/2 cotton count 5.2 Z wraps per inch x 5.4 S twists per inch final yarn. This final yarn contains a binder yarn, which is the 30 denier 12 filament yarn wrapped around each end of the 2 plies. This 30 denier yarn is a copolyamide nylon having a melt point range of 105-
10 180°C. The remainder of the 3.35/2 cotton count yarn is AlliedSignal T317 nylon-6 staple fibers having a melt point range of 215-225°C, which results in a blend of about 2.0 percent binder. This ratio can be increased by using a larger denier binder yarn, or by a low weight percent of heat-activated adhesive fibers and a high weight percent of non-adhesive AlliedSignal T317 nylon-6 staple fibers blend being
15 in the continuous bundle (sliver) of base staple fibers, before wrap spinning, that is wrapped with the 30 denier 12 filament binder yarn.

This final 3.35/2 cotton count yarn was twist set by a conventional stuffer box Suessen twist setting process. The yarn was passed through a heated chamber at 190°C, while in a relaxed condition, with a residence time of 60 seconds.
20 Multiple ends of this yarn were tufted into cut-pile carpet and conventionally finished to obtain the improved product. The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent non-adhesive AlliedSignal T317 nylon-6 base staple fibers. The carpet containing the 2.0 percent wrapper yarn binder displayed tighter and more defined individual pile tufts, a more
25 resilient, stiffer hand, enhanced carpet surface appearance with significantly less hairiness, and better wear resistance.

EXAMPLE 4

30 Carpets also may be produced by introducing a binder yarn at ring spinning before the front delivery roll into a continuous bundle of base staple fibers being

drafted to produce a ring spun yarn. The binder yarn can consist of 100% heat-activated adhesive fibers or consist of a blend of heat-activated adhesive fibers and non-adhesive fibers. Binder yarns as such can be either continuous filament yarn or spun staple yarn produced by conventional manufacturing methods. This ring spun
5 yarn has greater strength due to the added strength of the inserted yarn in the total spun yarn structure, which results in improved operating performance at spinning by reducing single end breakouts.

The resulting ring spun yarn when later twisted into a plied yarn and twist set by conventional processes results in a treated yarn with altered, unique
10 performance properties. The unique properties are produced by the heat activated adhesive fibers in the inserted binder yarn being intermingled within the continuous bundle (sliver) of non-adhesive base staple fibers during the ring spinning process, melting during conventional twist setting processes, and then solidifying when emerging from the elevated temperature forming a durable
15 crossbonding with the non-adhesive base staple fibers within the individual ends of the plied yarn and between the individual ends of the plied yarn.

The treated plied twist set yarn has a more resilient, stiffer hand, significantly improved ply twist retention, and a less hairy surface. When tufted into cut-pile carpet, the hand of the pile is significantly firmer, the individual tufts
20 are tighter and more defined, and the pile surface is cleaner with less hairiness. These carpet improvements can be further enhanced by the continuous bundle of base staple fibers being a blend with a low weight percent of heat-activated adhesive fibers and a high weight percent of non-adhesive fibers in which the binder yarn is inserted as described above.

25 In this example, a 30 denier 12 filament yarn is inserted before the front delivery roll into the continuous bundle of base staple fibers (sliver) being drafted at ring spinning. The sliver is 100% 17 denier per filament AlliedSignal T317 nylon-6 staple fibers, which is spun into a 3.0/1 cotton yarn containing 4.8 "Z" twists per inch. This singles yarn is then plied with another singles end of the same
30 yarn to produce 3.0/2 cotton count 4.8 Z twists per inch x 4.1 S twists per inch final yarn. This final yarn contains a binder yarn, which is the 30 denier 12 filament

yarn inserted in each end of the 2 plies. This 20 denier yarn is a copolyamide nylon having a melt point range of 105-180°C. The remainder of the 3.0/2 cotton count yarn is AlliedSignal T317 nylon-6 staple fibers having a melt point range of 215-225°C, which results in a blend of about 1.7 percent binder. This ratio can be
5 increased by inserting a larger denier binder yarn at the front delivery roll, or by a low weight percent of heat activated adhesive fibers and a high weight percent of non-adhesive AlliedSignal T317 nylon-6 staple fibers blend being in the continuous bundle (sliver) of base staple fibers, before ring spinning, in which the 30 denier 12 filament binder yarn is inserted at the front delivery roll of ring spinning.

10 This final 3.0/2 cotton count yarn was twist set by a conventional Suessen twist setting process. The yarn was passed through a heated chamber at 190°C, while in a relaxed condition, with a residence time of 60 seconds. Multiple ends of this yarn were tufted into cut-pile carpet and conventionally finished to obtain the improved product.

15 The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent non-adhesive AlliedSignal T317 nylon-6 base staple fibers. The carpet containing the 1.7 percent inserted binder yarn displayed more defined individual pile tufts, a more resilient, stiffer hand, and a cleaner, enhanced carpet surface appearance which is more like a BCF cut pile carpet.

20

WHAT IS CLAIMED IS:

1. A yarn comprising
 - a. at least one bundle of fiber, said bundle being ring spun or wrap spun with
 - 5 b. a second fiber comprising a heat-activated binder material having a melting point range of about 105° to 190°C under ambient humidity conditions, said yarn comprising a total of 0.1 to 12 weight percent binder material.
2. The yarn of claim 1 comprising 0.25 to 10 weight percent binder material.
- 10 3. The yarn of claim 1 comprising 0.5 to 8 weight percent binder material.
4. The yarn of claim 1 wherein the bundle of fiber is staple fibers.
5. The yarn of claim 1 wherein the bundle of fibers is a sliver.
6. The yarn of claim 1 wherein the bundle of fibers is continuous filaments.
- 15 7. The yarn of claim 1 wherein the second fiber comprises a heat-activated binder fiber.
8. The yarn of claim 7 wherein said binder fiber is a copolyamide.
9. The yarn of claim 8 wherein said binder fiber is a copolyamide of the nylon 6/nylon 6,6 type.
- 20 10. The yarn of claim 1 wherein the bundle of fiber is nylon 6.
11. The yarn of claim 1 wherein the bundle of fiber is staple fibers wrap spun with the wrapping fiber, and the wrapping fiber forms substantially all of the heat-activated binder material.
12. The yarn of claim 11 wherein the staple fibers are selected from the
- 25 group consisting of nylon 6 and nylon 6-6, and wherein the heat-activated binder material is a copolyamide having a melting point range of 165° to 190°C under ambient humidity conditions.
13. An article made from the yarn of claim 1.
14. A tufted article made from the yarn of claim 1.
- 30 15. A carpet including the yarn of claim 1 as a face yarn.

16. A process for producing a yarn suitable for tufting, said process comprising the steps of:
- a. forming a bundle of fiber;
 - b. ring spinning or wrap spinning the bundle of fiber with a second fiber
- 5 comprising a heat-activated binder material having a melting point range of about 105° to 190°C under ambient humidity conditions to form a yarn comprising 0.1 to 12 weight percent of the binder material;
- c. heating the yarn sufficiently to melt the binder material; followed by
 - d. cooling the yarn to solidify the binder material.
- 10 17. The process of claim 16 wherein said heating step is accomplished during twist setting of the yarn.
18. The process of claim 16 wherein the bundle of fiber is formed by spinning staple fiber.
19. A wrap spun yarn made in accordance with the process of claim 16.
- 15 20. A ring spun yarn made in accordance with the process of claim 16.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/19745

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 D02G3/40 D05C17/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 D02G D05C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 20657 A (E.I. DU PONT DE NEMOURS AND COMP) 15 September 1994 see page 4, line 23 - page 6, line 22; claims 1,6,7; examples 1,2	1,2,4,6, 7,10, 12-16
A	---	17-20
X	WO 94 09196 A (ALLIED-SIGNAL INC.) 28 April 1994 cited in the application see page 4, line 34 - page 8, line 15; claims 1,6,7,9,10; example 5	1-20
A	---	1,4,5, 13-15
	GB 2 205 116 A (WOOL RESEARCH ORGANISATION OF NEW ZEALAND INC) 30 November 1988 see page 4, line 25 - page 6, line 15; claim 1; example 1 ---	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

19 January 1999

Date of mailing of the international search report

29/01/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.
Fax: (+31-70) 340-3016

Authorized officer

Munzer, E

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/19745

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 466 618 A (SA SCHAPPE) 15 January 1992 see the whole document ---	1
A	PATENT ABSTRACTS OF JAPAN vol. 97, no. 9, 30 September 1997 & JP 09 119034 A (UNITIKA LTD), 6 May 1997 see abstract ---	1
A	EP 0 444 637 A (E.I.DU PONT DE NEMOURS AND COMP.) 4 September 1991 see claims 1,4; figure 1; example 1 ---	1,6
A	WO 95 30040 A (KLEEN-TEX INDUSTRIES, INC.) 9 November 1995 -----	

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter: International Application No

PCT/US 98/19745

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9420657	A	15-09-1994	US 5284009 A	08-02-1994
			AU 692151 B	04-06-1998
			AU 6350994 A	26-09-1994
			CA 2158019 A	15-09-1994
			DE 69414562 D	17-12-1998
			EP 0694092 A	31-01-1996
			JP 8507835 T	20-08-1996
WO 9409196	A	28-04-1994	AU 680839 B	14-08-1997
			AU 5325194 A	09-05-1994
			CA 2145744 A	28-04-1994
			CN 1098448 A	08-02-1995
			DE 69304929 D	24-10-1996
			DE 69304929 T	30-01-1997
			EP 0665907 A	09-08-1995
			US 5478624 A	26-12-1995
GB 2205116	A	30-11-1988	AU 613957 B	15-08-1991
			AU 2226988 A	22-03-1990
			BE 1002262 A	13-11-1990
			EP 0359881 A	28-03-1990
EP 466618	A	15-01-1992	FR 2664621 A	17-01-1992
			AT 118827 T	15-03-1995
			DE 69107535 D	30-03-1995
			DE 69107535 T	14-06-1995
			DK 466618 T	08-05-1995
			ES 2068546 T	16-04-1995
			GR 3015636 T	30-06-1995
EP 444637	A	04-09-1991	US 5032333 A	16-07-1991
			AU 625486 B	09-07-1992
			AU 7192491 A	29-08-1991
			CA 2035754 A	28-08-1991
			DE 69101859 D	09-06-1994
			DE 69101859 T	27-10-1994
			JP 5044129 A	23-02-1993
WO 9530040	A	09-11-1995	AU 6820794 A	29-11-1995
			EP 0760875 A	12-03-1997